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Original Research Article

Gender and Stature Determination from Measurements of Biacromial Breadth Measurements Among Adults in Southern Rajasthan

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Abstract

Stature and gender determination and identification play an important role in establishing the identity of a deceased person. The forensic specialist is often mandated to partake in these exercises for effective identification of the deceased. The present study was conducted to ascertain the viability of a specific post cranial measurement, Biacromial breadth (BAB) in determining gender and estimating stature. The study revealed that though BAB can be used as an effective and significant marker for stature and gender determination, its efficacy in the selected population was not as significant as long bones.

Keywords: Biacromial Breadth, Gender, Stature.

Introduction:

Anthropometry is a systematic study of measurements on man and it involves scientific techniques for taking various measurements and somatic observations on the living man. As crime rate is increasing day by day, issue for human identification is of prime note. Branch of science that uses the data obtained from body parts and skeletons from the living or dead people for forensic purposes is called "Forensic Anthropometry". [1]

Identification of an unknown body of a person who died in mass disasters, wars, homicide, suicide or accidental deaths is a very important task in the fields of physical anthropology and forensic medicine. Estimation of the stature or the height is one of the steps for the identification . [2] Anthropometric variability (i.e. differences in size, shape of individuals of different ages) in Indian populations is remarkable due to the influence of various factors such

as nutritional and socioeconomic factors. Anthropometric patterns are likely to manifest considerable regional variations in a country like India because of the influence of a variety of factors such as nutritional and socioeconomic factors, diet, education, culture, ethnicity and genetics. [3,4]

Spradley and Jantz using a modern forensic sample, demonstrated that most bones of the post cranium outperform the skull in their sex discriminating capabilities. The authors used measurements from long bones of the upper and lower limbs as well as measurements of the vertebral column. The deduced that osteometric standards for estimating sex cannot be accurately applied to other disparate samples, as human groups differ with regard to body size, robusticity, and the degree of sexual dimorphism exhibited by the skeleton. In addition, populations may experience secular changes, thus requiring the use of temporally representative skeletal collections in the derivation of anthropological standards, including those for the discrimination of sex [5], thus the need arises to study the population in region and evaluate as well as formulate a scientific method which can be applied for stature and gender determination.

The present study was thus conducted to evaluate the utility of Biacromial breadth measurements in estimating stature and gender determination in an adult population of Bareilly.

Material and methods:

The present study was a cross sectional, observational study conducted among subjects from various medical teaching institutions in Udaipur, Rajasthan. The study availed a sample size of 300 individuals with 149 males and 151 females. Sample size was calculated with SPSS software allowing a hypothesis with a confidence interval of 95 %. The resultant sample size was then taken in the study to provide an adequate and statistically significant data collection. An attempt was made to collect same number of samples from both genders. The study was conducted between December 2020 to December 2021, in a period of one year.

The tools used in the study were an anthropometric scale (Stadiometer) for determination of stature, blunt end spreading calipers for measurements, Stationary and markers.

All the subjects were chosen as per the inclusion criteria as mentioned below and voluntary, informed, written consent was obtained prior to collection of anthropometric data.

Approval from Institutional Ethical committee was obtained prior to commencement of the study.

Inclusion criteria:

1. Adult males and females capable of giving informed consent.
2. Age between 20 years and completed 30 years only.
3. Residing in Udaipur, Rajasthan
4. Apparently healthy individuals were selected as subjects.

Exclusion criteria:

1. Age below 20 years and above 30 years.
2. Non – residents of Udaipur, Rajasthan.
3. Individuals with spinal deformities, H/O surgeries/ deformities affecting stature or Lower limb measurements such as malformed fractures, kyphosis/scoliosis, any other congenital or acquired abnormalities.

Observations:

Table 01: Distribution of Stature and Biacromial Breadth (BAB)

Parameter	Age	Stature (cms)	BAB (cms)
Subjects	300	300	300
Mean	22.56	159.9	43.77
Std. Deviation	2.78	10.01	4.4
Minimum	20	133.0	33.30
Maximum	30	181.0	47.00

In the combined study of all subjects, it was noted that the total sample size of 300 exhibited no missing data entries. The maximum stature as recorded was 181.0 cms while the other end of the spectrum was 133cms. Biacromial breadth (BAB) was found to have a minimum value of 33.30 cms and a maximum value of 47.00 cms with a mean value of 43.77 cms. The values are depicted in table 01 as above. The standard deviation among the values for stature were 10.01. The standard deviation for the measurements of BAB were calculated as 4.43. The age group under study varied between 20 years to 30 years

Table 02: Correlation between Stature and BAB measurement.

Parameter		Stature	BAB
Stature	Pearson Correlation	1	.965**
	Sig. (2-tailed)		.000
	N	300	300
BAB	Pearson Correlation	.965**	1
	Sig. (2-tailed)	.000	
	N	300	300

**. Correlation is significant at the 0.01 level (2-tailed).

Statistical analysis of the stature and Biacromial breadth of the entire sample population including both genders and all age groups showed a Pearson co relation to be significant at 99 % confidence interval. This means that there was a statistically significant co relation between stature and the measurements of the Biacromial breadth of population as a whole without any segregation of gender or age.

Table 03: Gender Distribution and Correlations with Biacromial Breadth (BAB)

Sex			Stature	BAB
Male	Stature	Pearson Correlation	1	.816**
		Sig. (2-tailed)		.000
		N	149	149
	BAB	Pearson Correlation	.816**	1
		Sig. (2-tailed)	.000	
		N	149	149

Female	Stature	Pearson Correlation	1	.681**
		Sig. (2-tailed)		.000
		N	151	151
	BAB	Pearson Correlation	.681**	1
		Sig. (2-tailed)	.000	
		N	151	151
**. Correlation is significant at the 0.01 level (2-tailed).				

Statistical analysis of the stature and Biacromial Breadth of the sample population of male and female population groups showed a Pearson co relation to be significant at 99 % confidence interval. This means that there was a statistically significant co relation between stature and the measurements of Biacromial Breadth of male and female population as a whole without any segregation of age.

Linear regression analysis of data of Biacromial Breadth (BAB) of males and stature revealed a equation as derived by simple linear regression analysis as follows:

Y = 0.3979 (X) – 22.154

Where Y= Stature of Individual.

X = Biacromial Breadth

R^2value of the equation was 0.38722 at 95 % CI

Linear regression equation as depicted above has been formulated with a R^2 value of 0.38722. This denotes that the predictive value is significant but not highly significant in determining the variable component i.e. stature in this case from the definitive component i.e. Biacromial Breadth in males of the study population.

Linear regression analysis of data of Biacromial Breadth (BAB) of females and stature revealed equation as derived by simple linear regression analysis as follows:

Y = 0.3362 (X) – 13.975

Where Y= Stature of Individual.

X = Biacromial Breadth

R^2value of the equation was 0.38791 at 95 % CI

Linear regression equation as depicted above has been formulated with a R^2 value of 0.38791. This denotes that the predictive value is significant but not highly significant in determining the variable component i.e. stature in this case from the definitive component i.e. Biacromial Breadth in females of the study population.

A binary simple logistic regression analysis was done for assessment of gender determination by Biacromial Breadth (BAB) for the data collected from the sample population. In determination of gender from Biacromial Breadth of the sample population the equation was derived as follows,

-9.552 + 0.292 x (A) = B

where A = Biacromial Breadth,

B = Male gender if positive, Female gender if negative

The results of the equation for Biacromial Breadth were that if the value is negative, it has a probability for being of female gender, while positive value has more probability for male gender of the population group under study.

Table 04: Calculation of Percentage of Accuracy of Biacromial Breadth in Prediction of Gender

Observed		Predicted		
		Sex		
		Male	Female	Percentage Correct
Sex	Male	109	40	73.6 %
	Female	26	125	82.8 %
Overall Percentage				78.3 %

R^2 Value = 0.693 (Cox and Snell Method)

The prediction and evaluation of efficacy were calculated by comparison of recorded / observed values with values derived after formula substitution in SPSS software. The values upto second decimal point were included in the comparison. It was found that Biacromial Breadth was a better predictor of gender in females as compared to males with a total efficacy of 78.3%.

Discussion:

The objective of the study was to evaluate the efficiency of stature estimation and gender determination from Biacromial breadth among the population set. The authors concluded that there exists a significant correlation of height with the inter-acromial length of an individual in both the sexes and that stature can be estimated with the inter-acromial length when only upper part of the trunk is available. The correlation matrix of the study showed that the use of a single regression equation to predict stature from the measurements of inter-acromial length does not make a great difference from individual measurement equations based on sex. In our study we also found that the measurements of Biacromial breadth was an effective predictor of stature. This is in concurrence with a study by Koulapur V who used a smaller sample size of 150 individuals and a narrow age range of 23-24 years only. No gender determination factors were reported by the author. [6]

In terms of gender distribution in Biacromial breadth, a statistically significant correlation was found between stature and values of

Biacromial breadth among both males and females of the study population. The correlation measured by means of P value was found to be significant in males and females. This indicates that the values of Biacromial breadth among males are very good predictors of stature but comparably less when compared to females or measurements from long bones.

This is in concurrence with research by Amit A Mehta, Christian Armah, Anam E and twisha shah, who have concluded that measurements long bones are better predictors of stature as compared to other bones of the body. [7-10]

In terms of the regression equations, no equation holding similar value of Coefficients was found in studies by previously mentioned authors. This is in concordance with conclusions by Twisha Shah, Mohanthy N K and Anitha M R, who stated that population specific studies are needed as population groups may show different regression equations. The need for these studies is based on the fact that morphometric measurements among different population groups shows variability in frequency and distribution leading to flawed results if applied to another group. [7,11,12]

In aspects of gender determination, A Igiri conducted a study in 2009 among 500 nigerian subjects on the efficacy of Biacromial breadth and waist circumference in ascertaining gender. The author noted that BAB was a better predictor of stature as compared to waist circumference. We found a similar result in which Biacromial breadth is a better predictor of stature. The authors noted that the predictive power of BAB was better in females as compared to males, which is again concurrent to our study. [13,14]

Conclusion:

There are a variety of studies that enumerate relationships between stature and percutaneous measurements of the body. The studies were unanimous in stating that a relationship exists that may or may not conform to the devised regression equations as derived by our study, however every author(s) has mentioned a equation that aids in delineating the stature.

Authors from various regions of the country and abroad have attempted to discern an equation that may be applicable to the general population or even universally, but the equations cannot counter the demographic and racial diversity and provide for a singularity that may prove applicable in proper effect to the whole population. Thus it was decreed by a variety of review papers and original articles that it is indeed the need of the day to enhance studies at a community or region level and formulate equations that cater to the specified demography or population subgroup.

Limitations: The study is limited in its small sample size and lack of applicability in entire population subset of the region

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